Studying Matrix Method for Reflex Diagnostic of Pancreas Spasmodic Muscle Zone

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Abstract: The article discusses the case-study ofreflex diagnostic methods for drug-free treatment of the pancreas via measuring electric potentials in Zakharyin-Ged zone by using 16 matrix electrodes. The matrix method of measurements made it possible to determine the distribution and localization of a muscle spasm in the pancreatic zone. The latter is very important for reflex treatment methods. The method underwent testing in clinical practice.

Keywords: Reflex diagnostic, Zakharyin-Gedzone, muscles spasm in the pancreas zone, matrix method, Voll's method.

Introduction

Reflex diagnostic and reflexology are important sections of the medical science. Detailed information and a comprehensive reference list in Russian on these methods can be found on the "Reflexology and reflex diagnostic" website (http://www.infamed.com/rt/). In 1999, the Ministry of Health Care of the Russian Federation addressed this problem in its order No. 38 of February 3, 1999 "On Measures for Further Development of Reflexology in the Russian Federation". The annexes to this regulatory document specified mandatory list of diagnostic and treatment procedures, which included the methods of reflex diagnostic and therapy.

Zakharyin-Ged zones (ZG) are certain skin areas, in which reflected pains, along with hyperesthesia to pain and temperature, appear in the conditions of internal organs' diseases. The occurrence of ZG zone is associated with sensory transduction received from the problematic internal organ and nerve endings, conducted from it to the spinal centers. The arising reflex irritability of the spinal centers is projected onto certain areas of the skin that innervate specific roots of the spinal cord. In ZG zones, in response to the pathological process, painful densified areas of the muscle tissue are often formed in the internal organs. These densified areas act as trigger points localized in the muscles, fascia and ligaments of the anterior abdominal wall in response to reflex irritability of the spinal centers.

Painful muscle spasm is a tonic muscle tension that occurs in response to the sensory transduction caused by pain. Each local pain causes a spinal sensorimotor reflex, accompanied by activation of motor neurons, which, in turn, leads to a spasm of the muscles innervated by those

neurons. Myofascial pain syndromes can develop against the background of reflex muscular-tonic vertebrogenic syndromes, complicating their course. Processes with such complex interrelations require maximum number of techniques for diagnosing a muscle condition and muscle relaxing effects [1].

Analyzing literary sources, we can conclude that reflex methods, in addition to mechanical and biophysical effects, use physical ones as well, such as heat, light, and direct and alternating electric currents of various frequencies. The detailed analysis of all known reflexology methods and reflex effects can be found, for example, at http://www.infamed.com/rt/. Electricity-based physical methods of exposure are usually limited to using a single electrode with a diameter of its contact zone of at least 2-3 mm. However, in the reflex genous zone, the electric potential can have a spatially inhomogeneous distribution, which can be of great importance for the diagnosis and decision-making on the treatment methods.

Currently, there are no devices with matrix-type sensors having relatively high resolution and small diameter (over 8 electrode elements with a diameter fewer than 2 mm). There is also no information about such studies. In addition, according to the degree of the impact on the charge of the nerve endings in reflex genous zones, the influence of the microflow of the charge (electrons and ions) should be much more effective, since it creates electric potentials of a certain value. In this case, effects can be manifested both on nerve endings in the organs and on their projections on the skin, as well as on the nervous system as a whole.

Methods

An informative method for studying the functional state of the muscle tissue involves recording the electrical activity of muscles using electromyography [2, 3]. This method provides information on the vital activity of the muscle, which may somehow be related to the state of the spasm. However, it can hardly be used for detailed analysis of a muscle spasm.

Biological tissues have complex resistance when exposed to high-frequency current, which depends on the composition of the tissue, as well as on the structure, condition and frequency of external factors. This fact allows using the impedance parameter at different frequencies as a non-invasively measured diagnostic characteristic of a biological tissue [4, 5].

In recent decades, several approaches to the use of electrical impedance diagnostic of biological tissue have been proposed: bioelectric impedance analysis, electrical impedance spectroscopy (EIS), electrical impedance plethysmography and cardiography, electrical impedance tomography (EIT). The most promising research methods are EIS and EIT: they are non-invasive and relatively inexpensive. However, as far as we know, these methods are not used for a detailed analysis of the spasms.

Hence, in our study, we attempted to use the matrix structure sensor for reflex diagnostic using the case-study of ZG zone of the pancreas [4], projected onto the lateral surface of the eighth-tenth ribs and intercostal muscles on the left lateral axillary line, as well as on the muscles of the anterior abdominal wall at the level of the dividing line between the first and the second segments (if the distance between the navel and xiphoid process is divided into three equal parts, the navel being the reference point).

For the pilot study, the patient J. (72 y/o) with a diagnosis of chronic pancreatitis was invited. The patient suffered from this disease for a long time, he underwent various diagnostic methods confirming the diagnosis. He was complaining about the pain in the pancreas, nausea caused by the diet violation and with emotional stress, periodic loose stools and bloating, belching, and increased irritability. Examination by palpation above the ZG zone on the anterior abdominal wall revealed painful muscle seals along the pancreas, which were studied and affected by some exposure methods on the written consent from a patient. Of those methods, massage and vacuum therapy were chosen as the most studied contact effects.

For our research, we used a qualitative model for the dependence of the local electrical conductivity of the muscle environment on its spasmodic state. The latter affected a crucial parameter: specific conductivity depending on the concentration and mobility of the charge, which, in its turn, was clearly contingent with the density and degree of physiological and mechanical tension of the muscle zone.

To conduct the measurements, we used the standard scheme of the local current meter flowing through the zone focus and the part of the measuring circuit

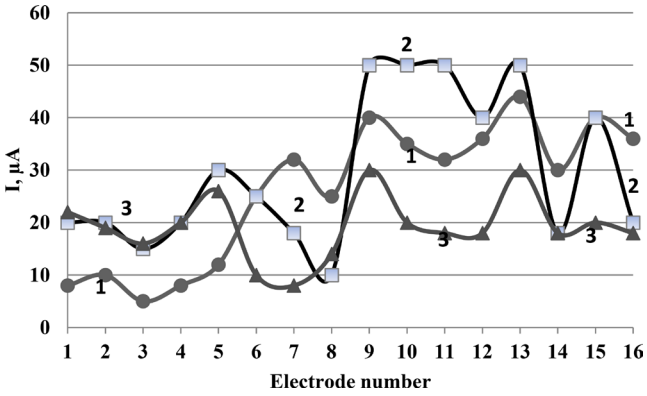

Figure 1. Signal distribution in the pancreas projection area "head": 1 – initially; 2 – after a massage session; 3 – after relaxation

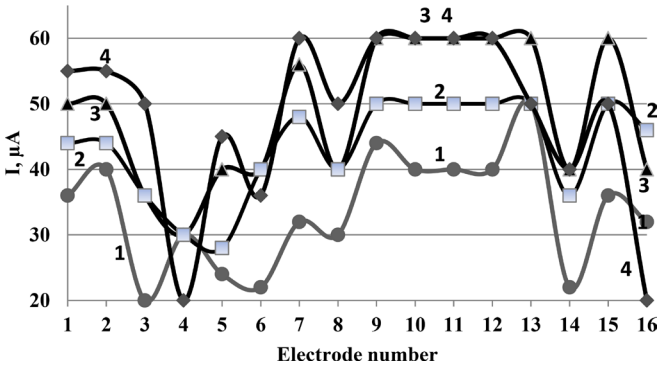

Figure 2. Signal distribution in the pancreas projection area "body". 1 – initially; 2 – after a session of vacuum therapy; 3 – after a massage session; 4 – after relaxation

(see, for example, http://odtdocs.ru/informatika/5633/index.html). The values of electrical parameters of the circuit elements were selected to match the middle of the scale (i.e. 50 graduations) corresponding to a measured resistance of 90 kOhm. The maximum (infinity)vs. minimum resistances were detected by the dial gauge pointing at 0 vs. one hundred graduations of the scale. Virtually linear resistance dependence on the measured current implied that the signal distortions determined by the method should be negligible. This measurement model allowed making qualitative estimates of dependencies. However, in evaluations of relative values and changes, it provided the data that were quite adequate to the actual biophysical state. We specified signal as measured relative values.

In our original method and measurement scheme, a single probe, conventionally used in the Voll's method, was replaced with a square matrix consisting of 16 probe electrodes. Each electrode was made of steel alloy and had a gold-plated coating. The probe area at the end was ~1 mm^2. The probes were located at a distance of 5 mm from each other. The entire matrix area was ~1×15 mm. Readings were made sequentially on each probe. Switching between the probes was carried out by using the multi-position switch.

After taking measurements in three zones of the pancreas projection, the therapeutic effect was applied in two ways: general or local massage, and vacuum therapy of the reflex zone under study. After each procedure, measurements were taken. After all procedures were performed, the patient was prescribed a two-week therapy course, followed by the last control measurement.

Results and Discussion

Figures 1–3 show the distribution patterns of the measured signal during the experiment in different parts of the reflex genous zone: pancreas head, body and tail.

Figure 4 presents a distribution pattern after complete recovery as a result of the therapeutic exposure and treatment. The major results of our study are summarized below.

The primary (before treatment) condition of neural osteofibrosis (NOF is a pathological condition characterized by reflex neurodystrophic changes in soft tissues) of the foci, as measured by the proposed method, is characterized by the reduced potential over the tissues adjacent to the spasm site and nearly flat plateau of measurements above the densified area itself. The plateau usually amounted to 3–5 measurement points, which approximately corresponded to the NOF focus size.

The therapeutic effect on the reflex genous zone via massage and vacuum therapy changed the level of potentials, increasing all indicators by 10–20 units, slightly changing the overall picture of the measurements.

Potential measurements carried out before the next session, i.e 1–2 days later, were characterized by increase in the average value of the potentials and their leveling.

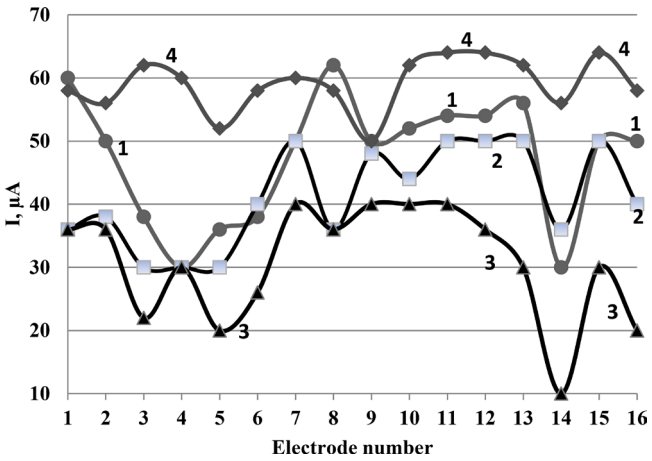

Figure 3. Signal distribution in the pancreas projection area "tail". 1 – initially; 2 – after a session of vacuum therapy; 3 – after a massage session; 4 – after relaxation

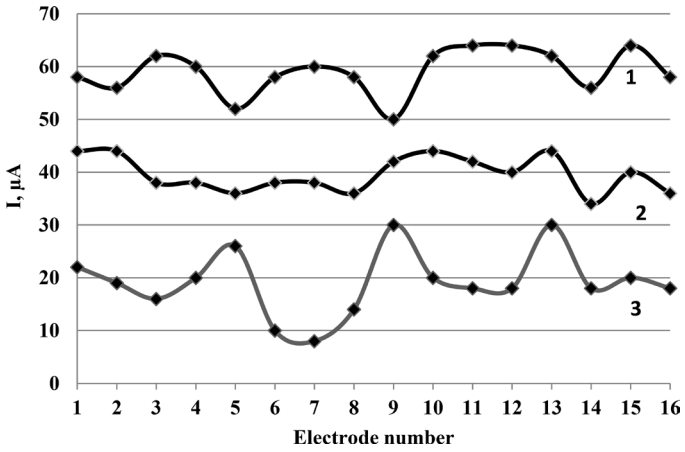

Figure 4. Current distribution in the areas of the pancreas projections two weeks after the treatment. 1 – head; 2 – body; 3 – tail

The NOF focus plateau and the change in the potentials of adjacent tissues are of interest. While the potentials above the spasmodic area were increasing uniformly, in adjacent areas, they were substantially decreasing, which, with a high degree of probability, was a consequence of reinforced innervation and blood flow in the NOF focus due to the so-called "robbing" of nearby tissues and, accordingly, lowering the potential.

Measurements made some time after the treatment completion exhibited uniformly aligned picture of the measured area with a slight fluctuation of potentials and the absence of both a plateau and former changes around it.

Conclusions

Our measurement data adequately matched to the changes of the clinical picture in the patient. Pain on palpation of the NOF lesion decreased, and its structure changed. From thick and sore to the touch, it turned into a softened tissue, insensitive to palpation.

Decisions on the completion of active treatment of the NOF foci were made on the basis of the clinical picture and measurement results. For example, after the exposure, weobserved the following changes in the patient J.:

- General condition subjectively improved along with work capacity;
- The above-listed symptoms have significantly decreased;
- Pancreatic reaction to dietary disorders decreased;
- Mood improved, while emotional state normalized;
- The patient began taking digestive enzyme preparations less often.

Thus, the measurement of potentials with a multi-needle probe above each NOF focus allowed:

- determining the localization of muscle spasm more accurately, which is very important for reflex treatment methods;
- tracing the relaxation and tension of the tissues inside the spasmodic area and around itin the dynamics, which helps determining the treatment tactics;
- determining the proper timing for completion of the procedures;
- prescribing home-based preventive treatment and identifying the turn out time.

The development of the method would require continuing clinical research based on advanced device with a matrix reader with at least 64 electrodes and digital data processing.

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